Emergency Medicine Practice
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Emergency Management of Renal and Genitourinary Trauma: Best Practices Update

CLINICAL CHALLENGES

- What are the historical findings and physical examination signs that suggest a patient has life-threatening renal and genitourinary trauma?
- What are the most effective laboratory and imaging strategies for patients with suspected genitourinary trauma?
- How should transport and referral decisions be made, based on injury grading?

***TRAUMA EXTRA* EDITOR-IN-CHIEF**
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Abstract

For polytrauma patients who may have life-threatening injuries, renal and genitourinary trauma may be overlooked initially, but a delayed or missed diagnosis of these injuries may result in potentially preventable complications. This review provides a best-practice approach to the diagnosis and management of renal and genitourinary injuries, with an emphasis on the systematic approach needed to identify subtle injuries and avoid long-term sequelae such as hypertension, incontinence, urethral stricture, erectile dysfunction, chronic kidney disease, and nephrectomy.

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Needs Assessment: The need for this educational activity was determined by a practice gap analysis; a survey of medical staff; review of morbidity and mortality data from the CDC, AHA, NCHS, and ACEP; and evaluation responses from prior educational activities for emergency medicine physicians.

Target Audience: This enduring material is designed for emergency medicine physicians, physician assistants, nurse practitioners, and residents.

Goals: Upon completion of this activity, you should be able to: (1) identify areas in practice that require modification to be consistent with current evidence in order to improve competence and performance; (2) develop strategies to accurately diagnose and treat both common and critical ED presentations; and (3) demonstrate informed medical decision-making based on the strongest clinical evidence.

CME Objectives: Upon completion of this article, you should be able to: (1) describe common and must-not-miss forms of renal and genitourinary trauma and their associated physical examination characteristics; (2) determine appropriate diagnostic testing through systematic and thorough examination; and (3) list common pitfalls in the care of the patient with renal and urogenital trauma.

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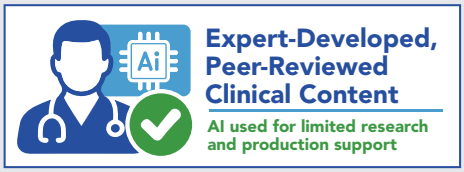

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Case Presentations

CASE 1

A 23-year-old man presents to the ED and tells you it hurts "everywhere"…

- He appears to be intoxicated and was involved in an altercation. He has bruises and red marks that look like shoe prints over his abdomen, flanks, and chest.
- On his right flank, he has a 1- by 2-cm wound he said was made by a screwdriver.
- His temperature is 36.5°C; heart rate, 135 beats/min; blood pressure, 85/49 mm Hg; respiratory rate, 24 breaths/min; and oxygen saturation, 97%.
- You consider whether a urinalysis will help in working up this patient. What kind of special imaging is he going to need?

CASE 2

A 46-year-old woman who was in a motor vehicle crash presents by EMS to the ED…

- She appears to be intoxicated, and EMS tells you that she was the unrestrained and ejected passenger in a high-speed, rollover, single-car crash.
- Her temperature is 38.3°C; heart rate, 107 beats/min; blood pressure, 86/68 mm Hg; respiratory rate, 18 breaths/min; and oxygen saturation, 94%.
- EMS has placed a pelvic binder, and a tense, swollen abdomen extends above it.
- During the resuscitation, you notice she is bleeding briskly from her vagina.
- Should you place a Foley catheter? Do you need to page urology and trauma as well?

CASE 3

A 54-year-old man who was in a high-speed motorcycle crash presents by EMS to the ED…

- He is screaming in pain and has an obvious chest wall deformity, with crepitus.
- He has a massive hematoma to his perineum and scrotum, a testicle that appears dislocated and free from the scrotum, and a deformity to his penile shaft. There is gross blood at the urethral meatus.
- His temperature is 36.1°C; heart rate, 144 beats/min; blood pressure, 103/81 mm Hg; respiratory rate, 31 breaths/min; and oxygen saturation, 88%.
- How do you begin assessing this patient's genitourinary trauma? Should you place a suprapubic catheter?

Introduction

Worldwide, it is estimated that 250,000 traumatic renal injuries occur annually.[1] The urological organ most commonly injured is the kidney, followed by the testicles and the bladder.[2] Depending on the data set used, renal and genitourinary (GU) trauma is present in 5% to 10% of all abdominal trauma patients.[3-5] Over the last 20 to 30 years, the care of renal and GU injuries has evolved, becoming

more conservative and expectant. Advances in military medicine, where 5% of all combat injuries are GU-related, have accelerated the pace of this change and advances in care.[6]

The principles of effective trauma care prioritize life- and limb-threatening injuries. Blunt and penetrating trauma that affects the kidneys or other GU organs is rarely isolated, and nearly all patients with penetrating or high-grade blunt abdominal trauma have multiple injured organs.[7,8] As a result, renal, bladder, and other GU injuries can be missed in the rush to contend with emergent interventions.[9-12] In one case series performed at a specialized trauma center, 23% of all bladder and urethral injuries associated with pelvic fracture were missed initially.[13]

Patients with GU injuries tend to be sicker than their cohorts without such injuries.[14-16] Missed renal and GU injuries are associated with increased morbidity and mortality.[15,17,18] Coordinated trauma care—particularly care that takes place in a designated trauma center—reduces the risk for nephrectomy and inpatient mortality in patients with renal trauma.[19] **Table 1** lists potential sequelae of renal and GU injuries.[18,20-22]

Long-term consequences of renal and GU injuries include hypertension, chronic kidney disease, erectile dysfunction, incontinence and voiding issues, urethral stricture, hydronephrosis, fistula, recurrent pyelonephritis, and nephrolithiasis.[4,18,23,24] Although hypertension is relatively rare as a late consequence (approximately 5%-14%), it is emblematic of the need to accurately and quickly diagnose these types of injuries to prevent potentially avoidable morbidity.[25-27] Recognizing and initiating treatment of these non–life-threatening GU injuries is vital in reducing the incidence of future strictures, impotence and other sexual dysfunction, and incontinence.[26,28,29]

Table 1. Potential Sequelae of Renal and Genitourinary Injuries

- Renal parenchymal scarring
- Stricture
- Thrombosis and ischemia
- Delayed nephrectomy due to bleeding, fistula, hypertension, or pseudoaneurysm formation
- Urinary leaks and urinomas
- Sexual dysfunction
- Abscess
- Peritonitis
- Sepsis

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This issue of *Emergency Medicine Practice: Trauma EXTRA!* will review common and uncommon traumatic GU emergencies and provide a best-practice framework for diagnosis and management.

Critical Appraisal of the Literature

A literature search was performed using PubMed and the services of a medical research librarian using the search terms *kidney trauma, renal trauma, ureteral trauma, bladder trauma, urethral trauma, genital trauma, penile trauma, urological trauma*, and *genitourinary trauma*. A total of 641 articles from 1968 to the present were reviewed. There are no reviews on this topic in the Cochrane Database of Systematic Reviews. There are 5 core, evidence-based and consensus guidelines on renal and GU trauma, noted in **Table 2**. Guidelines by the American Association for the Surgery of Trauma (AAST) organ injury severity system were also reviewed.

Table 2. Expert Guidelines in Renal and Genitourinary Trauma

Guideline, Year of Last Review	Type of Guideline	Main Recommendations That Impact Emergency Care	Strength of Evidence
American College of Radiology Appropriateness Criteria®: Major Blunt Trauma, 2019[40]	Evidence-based; graded based on literature review	• CT with IV contrast is the gold standard test in blunt GU trauma	Moderate to weak (grades 2-4)
American College of Radiology Appropriateness Criteria®: Penetrating Trauma—Lower Abdomen and Pelvis, 2019[41]	Evidence-based; graded based on literature review	• Indications and uses of CT cystogram and retrograde urethrogram in bladder and lower tract penetrating trauma	Moderate to weak (grades 3-4)
Urotrauma: American Urological Association Guideline, 2020[42]	Evidence-based; graded based on literature review	• Imaging indications and selection in GU trauma • Operative intervention versus observation	Moderate to weak
Kidney and Urotrauma: World Society of Emergency Surgery-American Association for the Surgery of Trauma Guidelines, 2019[43]	Evidence-based; graded based on literature review	• Imaging choices by mechanism, age, and hemodynamics • Nonoperative vs operative management	Moderate to weak
European Association of Urology Guidelines on Urological Trauma, 2024[26]	Evidence-based; graded based on literature review	• Initial evaluation and subsequent management of GU trauma	Moderate

Abbreviations: CT, computed tomography; GU, genitourinary; IV, intravenous.

The majority of recommendations on this topic are based on retrospective data, case series, meta-analyses, systematic reviews, and consensus statements. Well-designed prospective trials on GU trauma are rare.[30-32] Most articles are case reports, expert opinion pieces, or single-institution retrospective case series. The Multi-institutional Genitourinary Trauma Study (MiGUTS) has begun publishing prospective and retrospective data on this topic from numerous level I trauma

centers in the United States.[33-36] These studies are still the exception; the rest of the literature is relatively weak.[1,37] One expert, lamenting this dearth of quality literature on GU trauma noted, "Most studies repeat the same old messages/prejudices. One could argue that there has been no major advance in the (early) treatment of urethral trauma since 1757."[38] Although we disagree with that grim assessment of the recent advances in this field, expert consensus based on single-arm and/or retrospective observational studies is the norm in the literature presented here. A promising development in the recent literature is the inclusion of renal and GU trauma in the development of scoring systems to guide clinical care, including one to predict nephrectomy in renal trauma[39] and another to predict GU injuries in polytrauma patients.[17]

Epidemiology

The incidence of GU trauma is heavily skewed toward young (80% aged <45 years) and male patients (75% of all patients).[3,44] The kidneys are injured in approximately 5% of all patients admitted with trauma, making them the most frequently injured GU organs, followed by the ureter and bladder.[45] Among patients with a pelvic fracture from blunt trauma (especially anterior ring disruption), 6% to 8% will have a concomitant bladder injury.[43,46] In patients presenting with sports-related injuries, the external genitalia are the GU organs most frequently involved.[47]

Noniatrogenic blunt trauma mechanisms (most commonly from motor vehicle crashes) cause approximately 90% of injuries to the GU tract.[3] The rates of penetrating injury are substantially higher in low- and middle-income countries.[3] Only 5% to 18% of cases of penetrating trauma in the United States involve the kidneys or GU system, although this number appears to be rising.[3,5,8] Most penetrating trauma in the United States is the result of gunshot wounds (70%-80%), followed by stabbings.[3,11]

Because the ureter is well-protected from blunt trauma by its surrounding structures, it is the only GU organ that is injured more frequently by penetrating mechanisms. The kidney can be injured by both blunt and penetrating mechanisms, and these injuries are often associated with other severe injuries.[3] Injuries due to sexual encounters comprise a minority of injuries to the GU tract,[48] but these are important to identify in order to screen patients further regarding sexual abuse.

Etiology and Pathophysiology

For a summary of common types of injuries GU organs may sustain, **see Table 3**.

Table 3. Renal and Genitourinary Organ Injuries[43,49]

External Male Genitalia
- Scrotum
  - Contusion
  - Laceration
  - Avulsion
- Penis
  - Laceration (including fracture)
  - Penectomy

External Female Genitalia
- Contusion/hematoma
- Laceration

Kidney
- Contusion
- Hematoma
- Laceration
- Vascular (renal artery/vein)

Bladder
- Hematoma
- Laceration
- Rupture (intraperitoneal/extraperitoneal)

Ureter
- Contusion
- Laceration
- Transection
- Avulsion

Urethra
- Contusion
- Stretch injury
- Partial disruption
- Complete disruption/transection

Kidneys and Ureters

The kidneys and ureters are protected by adjacent anatomic structures, but are suspended from the renal pedicle, without other firm attachments. As a result, blunt trauma to these organs is usually secondary to a rapid deceleration injury, as opposed to direct trauma. The forces of deceleration can cause a spectrum of injuries to the parenchyma, from contusions to a shattering of the kidney. The vascular supply to and from the kidney can also be injured, which can lead to necrosis if left untreated.[50]

The main cause of ureteral injury (other than iatrogenic injury) is penetrating trauma. The ureter is injured in approximately 5% of penetrating wounds to the abdomen.[3] Penetrating trauma involving the ureter often involves simultaneous hollow viscus and vascular injuries.[43] Ureteral injuries due to blunt trauma are usually seen in conjunction with lumbosacral spine injuries and pelvic fractures, reflecting the extreme force that is needed to stretch or rupture the walls of the tubular ureter.[51]

Bladder

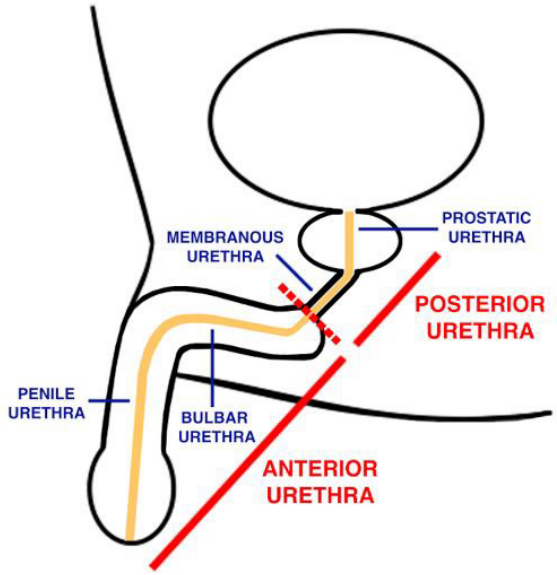
The spectrum of bladder injuries from blunt trauma ranges from mural contusions to complete rupture, typically resulting from extreme compressive forces on the bladder wall.[52] Ruptures are classified as *intraperitoneal* or *extraperitoneal*, with intraperitoneal ruptures occurring at the superior dome of the bladder and extraperitoneal ruptures occurring along the inferior aspect of the bladder. The majority of rupture injuries are intraperitoneal.[43] Pelvic fractures are often found in patients with bladder injuries, and while they typically reflect the extreme force of the trauma causing such an injury, they can also be the direct cause when the bony spicules penetrate the bladder.[52] Intraperitoneal bladder rupture results in urinary extravasation into the peritoneal cavity. Extraperitoneal bladder rupture similarly causes urinary extravasation, but the urine drains into the pelvic cavity.[53]

Male Genitalia

The male urethra is divided into the posterior segment (consisting of the prostatic urethra and membranous urethra) and the anterior segment (consisting of the bulbous, penile, and glandular urethra). **(See Figure 1.)** It is significantly longer than the female urethra, and thus more likely to be injured.[23] Because of the posterior urethra's proximity to the bladder, injuries to this segment are commonly associated with pelvic fractures and concomitant bladder injuries. Due to its external location in males, the anterior urethra is injured more commonly as a result of penetrating injuries.[3,43]

Penetrating and blunt mechanisms cause similar numbers of genital injuries in men, but the injuries that require admission most frequently—penile fractures and testicular rupture—are typically due to blunt trauma.[3] Penile fractures occur most often during sexual intercourse as a result of blunt force on an erect penis, causing a rupture of the tunica albuginea, which covers the corpora cavernosa. Urethral injury accompanies penile fracture in approximately 20% of cases.[54] Testicular rupture occurs when extreme blunt forces cause a rupture of the tunica albuginea that covers the individual testicles, causing an extrusion of the seminiferous tubules. Penetrating injuries can cause lacerations, contusions, avulsions, and even amputation of the scrotum or penis. Zipper injuries and burns are other possible causes of trauma.

Figure 1. Anatomy of the Normal Male Urethra



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Female Genitalia

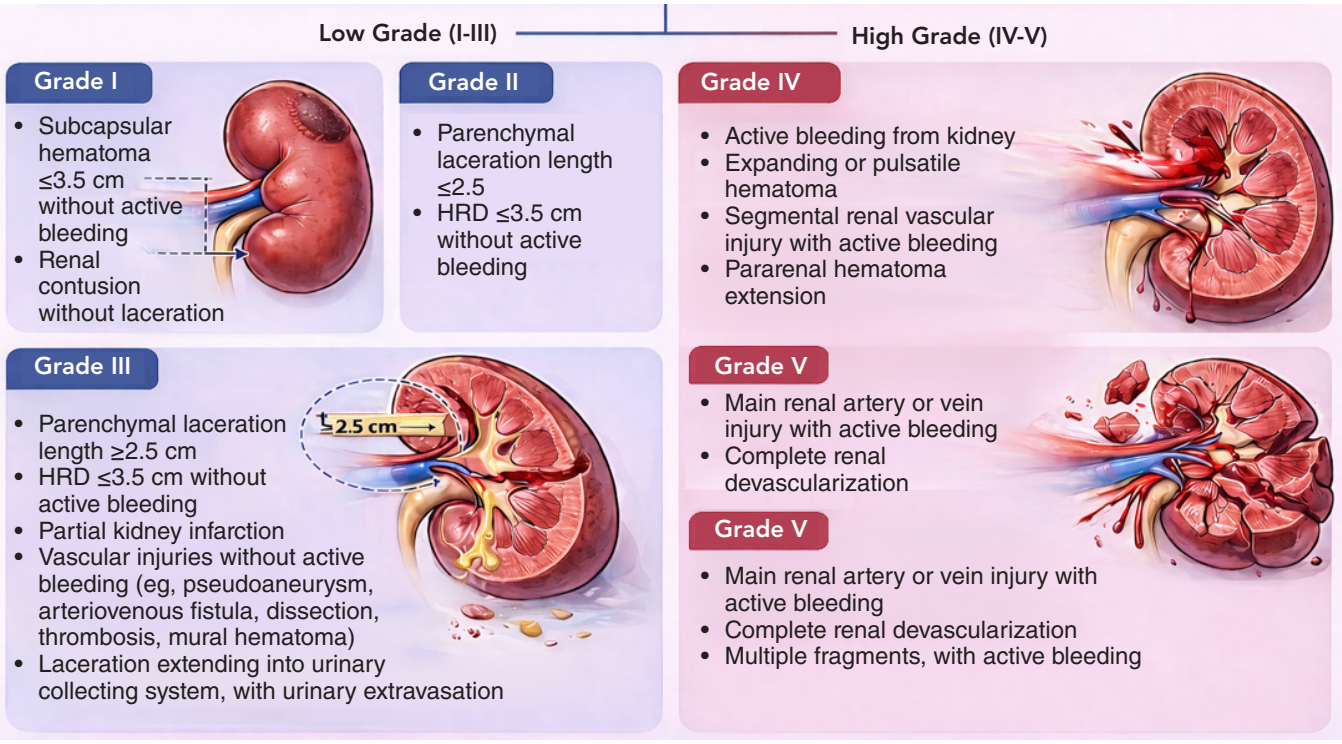
Female genital injury may be caused by blunt trauma and can result in lacerations, hematomas, or significant swelling and disfigurement. In women with genital injury, associated injuries of the urethra can occur and must always be considered.[55] Injury due to sexual violence should also lead to consideration of a gynecology consultation in the emergency department (ED).[56]

Differential Diagnosis

A range of injuries can occur for each organ of the GU tract. **Table 3 (page 7)** delineates the types of injuries, by organ, according to the AAST grading system.[49,57] The grading of renal injury was updated in 2018 and again in 2025 to include relevant computed tomography (CT) findings, as CT use has increased and is considered "near universal" in determining care plans.[49,58] Illustrations of the 2025 AAST kidney injury grading system can be seen in **Figure 2**. Key updates in the 2025 AAST grading system include:

- Multiple lower-grade injuries (grade I or II) no longer automatically elevate the overall grade; the focus instead is on maximum severity.
- Isolated, stable urine extravasation is generally considered to be grade III.
- Multifragmented kidney (MFK) scoring:
  - MFK is defined as ≥3 fragments;
  - MFK without active bleeding is downgraded to grade IV; and
  - MFK with active bleeding remains grade V.

Figure 2. Illustration of 2025 American Association for the Surgery of Trauma Kidney Injury Scoring[58]



Abbreviation: HRD, hematoma rim distance.
Hematoma rim distance: the maximum distance from the renal capsule to the outer edge of the perirenal hematoma, as measured on computed tomography.

Prehospital Care

Exsanguination from a severe kidney injury or genital injury can lead to shock. Concomitant injuries are very common and should be managed simultaneously. Pelvic fractures are seen frequently in patients with bladder or urethral trauma, and the use of a pelvic binder can decrease bleeding and aid in clot formation. Placement of a pelvic binder should be strongly considered when performing the patient's primary survey, as there is very little disadvantage to its use.

Obtaining history regarding the nature of the trauma can be very helpful in diagnosing and managing these patients, if this is possible to do without causing delays in transport; however, the unstable patient should be transferred expeditiously to a care facility with trauma capabilities. Isolated injuries to the GU tract do not require immediate transport to a trauma center unless the patient is hemodynamically unstable.

Emergency Department Evaluation

History

The value of a history from conscious patients, witnesses, and prehospital personnel cannot be overstated. In patients with blunt trauma, a blow to the flank or a rapid deceleration mechanism (eg, high-speed motor vehicle crash or fall from significant height) is suggestive of trauma to the upper GU tract. Rapid deceleration is associated with vascular injury to the kidney, such as avulsion of the vascular pedicle and renal artery thrombosis.[28]

Some historical features in renal and GU trauma are common in all abdominal trauma. For motor vehicle and motorcycle crashes as well as pedestrians struck, the speed of the vehicle(s) involved and whether the patient was restrained, ejected, or airborne are important considerations. Seatbelt use and airbag deployment are correlated to a decreased rate of kidney injury[59] and a lower rate of nephrectomy in renal trauma patients.[60]

In penetrating injuries, the size of the weapons used in stabbings and the type of gun in gunshot wounds can sometimes help prognosticate the nature and severity of the injury. Penetrating trauma to the lower chest and/or upper abdomen holds potential clues to underlying renal or ureteral trauma.[61] The patient's past medical and surgical history are also crucial in assessing for and evaluating renal and GU trauma. Pre-existing structural urologic pathology such as hydronephrosis, tumors, cysts, strictures, or solitary kidneys are highly associated with renal injury after even minor trauma, and necessitate a more intensive workup.[62-64] Pre-existing renal dysfunction is important to note, given the risk for trauma-associated acute kidney injury from insults such as hypotension, rhabdomyolysis, and contrast-associated nephropathy.[4,55,65]

Pre-existing urologic pathology that would make bladder sensation unreliable (eg, neurogenic bladder disorder) places patients at greater risk for missed injury.[66] Key historical features are summarized in **Table 4**.

Table 4. Key Historical Considerations in Renal and Genitourinary Trauma

- Blunt trauma: mechanism of injury, nature of deceleration (height or speed), use of restraints (eg, seatbelts)
- Penetrating trauma: specific type of gun and caliber, dimensions of stabbing weapon
- Prior urologic history (eg, hydronephrosis, cysts)
- Prior renal function
- Suprapubic discomfort, hematuria, or dysuria
- Difficulty voiding

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Ability to Void, Dysuria, and Hematuria

In the controlled chaos that may characterize the initial evaluation of trauma patients, some historical features and concerning symptoms can easily be missed. One example is the inability to void, which is sometimes attributed to pain from other injuries or to anxiety. Difficulty voiding is commonly seen, though gross hematuria is the most common sign of bladder injuries, occurring in 77% to 100% of cases.[55] A high index of suspicion should be maintained in patients presenting with difficulty voiding in the context of a straddle injury, trauma to the perineum, or pelvic fracture.[28] "Reflex retention" is a phenomenon seen in lower GU tract trauma, and it can be easily assessed with a bedside ultrasound or bladder scanner in patients with or without a urinary catheter in place.[38,67] For patients with delayed presentation, eliciting any instances of dysuria or hematuria is essential in risk-stratifying their likelihood of GU injury.[28] Delayed onset of gross hematuria after injury raises the possibility of the rare but potentially life-threatening complication of renal artery pseudoaneurysm.[68,69]

Physical Examination

Examination findings for patients with GU trauma can be obvious, subtle, or even absent. The patient should be undressed fully to identify the location of any penetrating injuries and identify subtle findings, such as perineal ecchymosis, that might indicate a deeper injury. Though it sounds obvious, this is often skipped, and it is the only way to accurately identify genital injuries that commonly occur with urologic injuries.[17]

The most lethal GU injury—kidney trauma—can exist with minimal to no physical examination or ultrasound findings, especially when it occurs in isolation,[63] highlighting the importance of considering renal trauma in patients with mechanisms that may put them at risk, such as rapid deceleration and direct flank trauma. Physical examination findings that may be seen in patients with blunt renal trauma include left upper quadrant or flank tenderness and ecchymosis, loss of flank contour, and fractured ribs.[55]

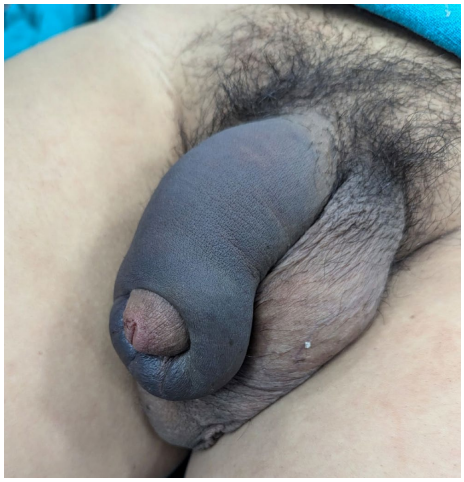
Ureteral injuries rarely occur in isolation and, by themselves, do not usually produce any physical examination findings. Injuries to the lumbosacral spine and pelvis following blunt trauma should raise suspicion for ureteral injury.[55] Intraperitoneal bladder rupture can cause abdominal distension and pain due to urinary extravasation, while extraperitoneal bladder rupture is highly associated with pelvic fractures and resultant pain and bruising in the pelvic area.[70]

Blood at the urethral meatus is the most common finding seen with urethral trauma, although genital hematomas, bruising, or swelling can also be seen in these patients.[55] Urethral trauma can also result in the inability to urinate, causing bladder distension apparent on physical examination.[71] Pelvic fractures should also raise the suspicion for urethral injury. Classically, digital rectal examination has been taught as a method to diagnose urethral transection via a "high-riding" prostate, but digital rectal examination has extremely poor sensitivity.[72] Moreover, Ball et al found in a retrospective review that only 1 of the 41 patients with urethral disruptions (2%) had a high-riding prostate on examination.[73] As evidenced, digital rectal examination is not a sensitive enough test to rule out urethral injury, and it is no longer recommended by the American College of Surgeons in Advanced Trauma Life Support©.[74,75]

Both penile and scrotal injuries can result in tenderness, swelling, ecchymosis, and lacerations. Significant swelling in the scrotum can limit the testicular examination.[76] Penile fractures typically present with significant bruising and swelling and can cause an "eggplant deformity," due to the ecchymotic swelling as well as disruption of the tunica albuginea.[77] **(See Figure 3.)**

Given the high incidence of urologic injury with genital trauma in women, examination under anesthesia should be considered for patients who are not able to tolerate a thorough pelvic examination but who have findings concerning for genital injury, such as labial bruising, bleeding, swelling, or tenderness.[78]

Figure 3. Eggplant Deformity



Sandeep Sapkota, Amisha Adhikari, Narayan Dulal. Penile fracture; an emergency managed successfully in a rural setting: a case report. *Clinical Case Report.* 2026. Volume 14, Issue 1. e71793. John Wiley & Sons Ltd. Reprinted with no changes by Creative Commons Attribution 4.0 International Deed

Diagnostic Studies

Laboratory Studies

Baseline Renal Function

Although baseline renal function is assessed axiomatically in nearly all trauma patients, the initial creatinine measurement will reflect pre-existing renal insufficiency and does not reflect the impact of any renal or GU injury.[26]

Urinalysis

Understanding the limitations of the urinalysis in renal and GU trauma is central to clinical decision-making. Urinalysis should be performed on all abdominal trauma patients. If renal or GU injury is suspected, the first spontaneously voided sample of urine has the highest sensitivity to identify hematuria, before fluid administration or diuresis can obscure its presence.[50,79] Offering a urinal or bedpan after initial stabilization can help facilitate this. *Hematuria* is defined as >5 red blood cells (RBCs) per high-power field (HPF). This is ascertainable by urine dipstick, although differing brands may have variable specificity and sensitivity, with a false-negative rate up to 10% reported.[4,80] Differentiating between gross and microscopic hematuria is important, with most experts putting the break point between the two at 30 to 50 RBCs/HPF.[80] Morey et al found that, in 53 patients with bladder injury, 100% had hematuria and 85% had pelvic fractures.[66] Numerous other studies found similarly high correlations between hematuria and pelvic fractures.[28]

Hematuria in Blunt Trauma

Based exclusively on retrospective data on patients with blunt trauma, gross hematuria is the single best indicator of injury, and can be found in up to 90% of patients with renal injuries.[81] In patients with blunt trauma, there is a correlation between the degree of hematuria and the likelihood of intra-abdominal injury not related to the GU system.[81] Currently, there is expert consensus that, in patients with blunt abdominal trauma, gross hematuria or microscopic hematuria with hypotension (systolic blood pressure <90 mm Hg) are indications for imaging to investigate for renal or GU injury.[42,62,81] This was derived from and validated by a number of large prospective and retrospective studies of renal trauma patients and their need for imaging.[82-84] Nonetheless, absence of hematuria is insufficient to ensure that no renal or GU injuries are missed. One series of 396 patients with renal injury after a fall found that 21% of patients with grade II to IV renal injury had no hematuria, and 15% to 45% of patients with ureteral injuries had none.[85,86] The absence of hematuria also does not rule out a renovascular injury, with numerous case reports describing a negative urinalysis in patients with complete renal pedicle avulsion, ureteropelvic junction disruption, and other severe injuries.[28,80,87,88] A 25-year case series from San Francisco General Hospital also found that the absence of hematuria was not enough to rule out ureteral injury.[89]

Hematuria in Penetrating Trauma

In penetrating trauma, there is no correlation between the degree of injury and the amount or even the presence of hematuria.[26,61,81,90] The American Urological Association and the European Association of Urology have published guidelines (summarized in **Table 5**) that aim to strike a balance between the overuse of imaging for any degree of hematuria and missing injuries in patients without hematuria but with a mechanism likely to produce significant renal or GU trauma.[26,55] This expert consensus recommends CT in patients with 5 to 30 RBCs/HPF when there is hypotension or other signs of shock, or other injuries that would require it (eg, a positive focused assessment with sonography in trauma [FAST] examination), which is to say that the hematuria alone does not mandate a CT. It recommends serious consideration of CT imaging without any RBCs in a urinalysis for a rapid deceleration mechanism (such as a high-speed motor vehicle crash or a fall from a height), direct trauma to the flank with significant pain and/or ecchymosis to the flank area (such as from a punch or kick), or adjacent fractures of the ribs or spine. There is little evidence to formally guide clinicians on how to quantify the amount of force to the flank that, even without hematuria or hemodynamic instability, would necessitate a CT.

Table 5. American Urological Association and European Association for Urology Guidelines for Computed Tomographic Imaging in Patients With Renal and Genitourinary Trauma[26,55]

- Blunt abdominal trauma and gross hematuria ("strong" or grade B; clinical studies without randomized controlled trials)
- Blunt abdominal trauma, shock (systolic blood pressure <90 mm Hg in the field or during resuscitation), and microscopic hematuria ("strong" or grade B)
- Blunt trauma with injuries known to be associated with renal injury such as rapid deceleration, direct contusion to the flank, flank ecchymoses, or fractures of the lower ribs or thoracolumbar spine, regardless of the presence or absence of hematuria ("strong" or grade C; expert consensus)
- Penetrating trauma to the upper abdomen or lower thorax regardless of the presence or absence of hematuria ("strong" or grade B)

Imaging

Computed Tomographic Imaging

CT imaging is the gold standard for assessing renal and GU trauma. It is more sensitive and specific than intravenous (IV) pyelogram, ultrasound, or angiography. CT better detects, localizes, and characterizes the nature of injuries and concomitant trauma and is particularly useful in evaluating injuries in patients with pre-existing urological structural abnormalities.[26] The only indication for using IV pyelogram over CT is the so-called "single shot" IV pyelogram that is performed perioperatively in unstable patients who require immediate operation for other injuries, making CT imaging impossible.

Table 6 suggests the preferred first-line imaging for various clinical scenarios.

Because renal and GU injury can be present without hematuria or hemodynamic signs, clinician gestalt based on the mechanism of injury and physical examination is essential.[42]

Table 6. Preferred Imaging Modality Based on Location of Injury

Location	Imaging Modality
Kidneys	CT with IV contrast and delayed images
Ureters	CT with IV contrast and delayed images
Bladder	CT cystography
Urethra	Retrograde urethrogram
Penis	Ultrasound or magnetic resonance imaging
Scrotum	Ultrasound

Abbreviations: CT, computed tomography; IV, intravenous.

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For patients stable enough to undergo CT, all expert guidelines recommend an immediate IV-contrast study. Findings on CT that suggest major renal injury include (but are not limited to) hematoma, urinary extravasation, and lack of contrast enhancement of the renal parenchyma.[55] Because modern helical CT scanners generally obtain images before contrast is excreted in the urine, scans can miss significant injuries to the renal pelvis, collecting system, and ureter.[91-93] In a study of patients with ureteral injury from blunt trauma, conventional CT missed 80% of injuries, and they were discovered only on delayed imaging, after complications ensued.[93] In a retrospective study of 115 patients, 33% of patients with high-grade renal injuries had a collecting system injury missed due to the absence of delayed excretory CT images.[94] When there is a high-grade renal injury (grade IV or V), ureteropelvic junction injury, or any concern for ureteral injury based on gestalt or first CT, approximately 10-minute-delayed additional CT images of the pelvis should be obtained to look for telltale abnormalities such as extravasation, periureteral urinoma, or a lack of contrast distal to the suspected ureteral injury (level III/C evidence).[28,55,91,94-96]

Computed Tomographic Cystography

Routine CT of the abdomen is often not enough to detect bladder injury.[15,40,41,43] Even clamping the urethral catheter and letting the bladder distend is sometimes not sufficient.[97] CT cystography is performed when there is gross hematuria or pelvic free fluid without another explanation other than bladder injury and when there are pelvic fractures (other than acetabular fractures) on the initial CT.[15,43,98,99]

Table 7 lists recommendations for identifying which patients need CT cystography. **Figure 4 (page 16)** shows an example of a positive CT cystogram.

Table 7. Recommendations for Use of Computed Tomographic Cystography[40,41,43,52,66]

- Gross hematuria or pelvic fluid with pelvic fracture
- Gross hematuria without other injury to explain it
- Microscopic hematuria with pelvic fracture
- Isolated microhematuria with clinician concern
- Difficulty voiding or suprapubic pain and any hematuria
- Penetrating injuries of the buttock, pelvis, or lower abdomen with any hematuria

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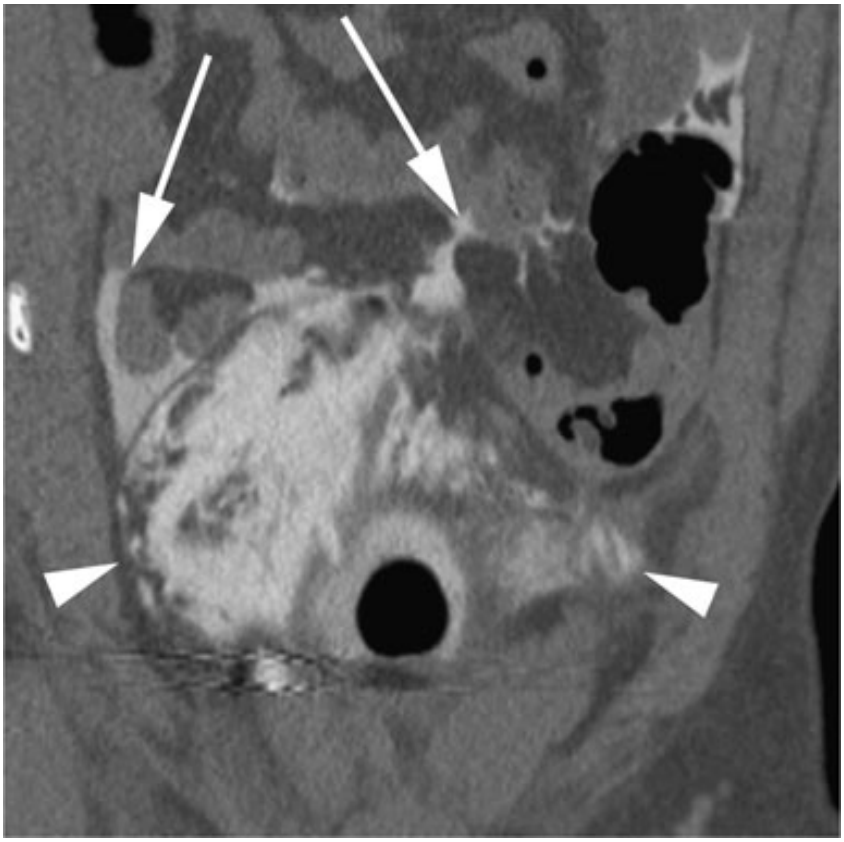
CT cystography and cystography performed in the cystography suite are interchangeable and equally sensitive and specific.[100] The sensitivity of CT cystography in detecting bladder injuries is 78% to 100%.[53,98,101] CT cystography is performed by draining the bladder via urethral catheter, instilling 350 mL of diluted, sterile CT contrast (made with 30 mL of contrast in a 500 mL bag of warmed normal saline) into the bladder by gravity, clamping the urethral or suprapubic tube, and obtaining CT images of the pelvis.[52] There is no need for a subsequent postvoid film.[100]

Figure 4. Positive Computed Tomographic Cystogram in a Patient With Penetrating Trauma and Bladder Rupture



Computed tomographic cystogram after penetrating trauma shows extensive contrast around the bladder (white arrowheads) as well as bowel loops and mesenteric folds in the peritoneum (white arrows).
Lower male genitourinary trauma: a pictorial review. Bruce E. Lehnert, Claudia Sadro, Eric Monroe, Mariam Moshiri. *Emergency Radiology.* Volume 21; 2013. ©2013 American Society of Emergency Radiology. With permission of Springer Nature Customer Service Center.

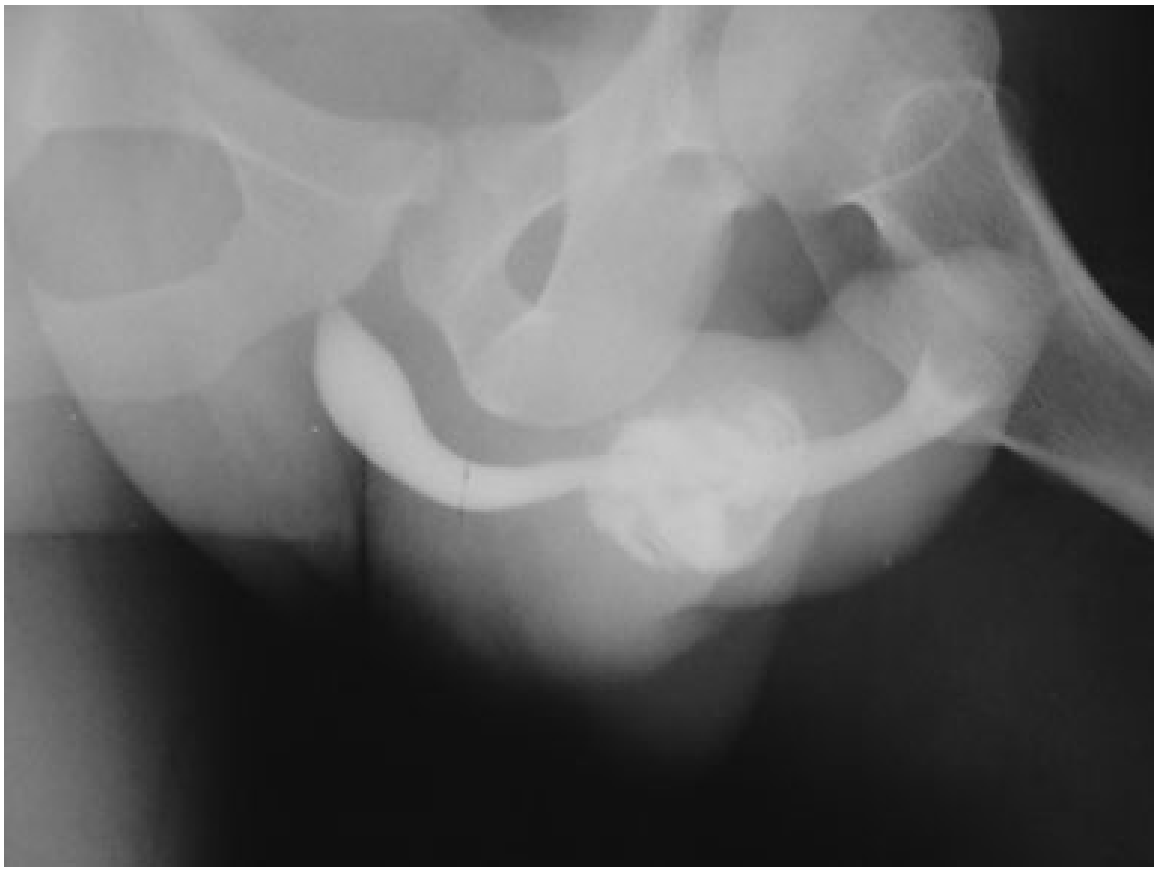
Computed Tomographic Angiography

CT angiography is sometimes performed, generally preoperatively, to localize acute arterial hemorrhage in preparation for surgical repair and/or embolization.[102] CT with or without angiography has been used in some institutions to determine the need for embolization.[103]

Retrograde Urethrogram

If there is concern for urethral injury, as suggested by blood at the urethral meatus, pelvic fracture, the inability to urinate, or significant pelvic swelling or ecchymosis, a retrograde urethrogram (RUG) should be performed prior to blind insertion of a urinary catheter.[40,41,104] The RUG is performed by gently stretching the penis over the thigh at an angle, to radiographically visualize the entire urethra, and then performing an x-ray as a scout for comparison. Next, contrast is instilled into the urethral meatus. An abdominal radiograph is then performed to evaluate for contrast extravasation along the course of the urethra, which would indicate urethral disruption. If there is complete disruption, the bladder will not fill with contrast. The sensitivity and specificity of RUG are extremely high, and because it can be performed at the bedside, it is superior to CT for acute trauma evaluations.[105] **Figure 5** is an example of a positive RUG.

Figure 5. Retrograde Urethrogram Performed in a Patient With a Penile Fracture



Note the contrast extravasation within the penile shaft, indicating a concomitant anterior urethral injury.
Andre Cavalcanti, Renato Krambeck, Alexandre Araújo, et al. Management of urethral lesions in penile blunt trauma. *International Journal of Urology*. 2006. Volume 13, Issue 9. With permission of John Wiley and Sons.

Because urethral injuries are not life-threatening and because the injected contrast can potentially interfere with the interpretation of contrast-enhanced CT scans, RUGs are typically performed in a delayed fashion, but they still can occur in the ED. An abnormal RUG should prompt immediate urology consultation. In the interim, blind passage of a urinary catheter should not be attempted, to limit any further damage to the urethra. If RUG reveals disruption of the urethra and the bladder is markedly distended, suprapubic catheterization can be considered for bladder decompression.[42,43] If a urinary catheter has already been placed but urethral injury is suspected, a pericatheter RUG can still be performed by introducing a pediatric catheter (4-6 French) beside the urinary catheter into the distal urethra, and then injecting contrast.[106]

Ultrasound

FAST examination via bedside ultrasound can be very helpful in identifying intraperitoneal free fluid, as would occur from intraperitoneal bladder rupture, and it has also been used to identify the site of bladder rupture.[105] However, due to its poor sensitivity, FAST has minimal utility in diagnosing renal parenchymal trauma or retroperitoneal bleeding. CT scanning with IV contrast is typically the imaging modality of choice for traumatic injuries to the upper GU tract.[26,43,50]

Formal ultrasound can be obtained to confirm penile fracture (though the diagnosis is typically made clinically) or to evaluate for testicular injury, as it can help distinguish between testicular contusion and rupture.[55,107] Doppler examination for blood flow within the scrotum can help determine the viability and vulnerability of the tissue.[108,109]

Magnetic Resonance Imaging

Magnetic resonance imaging can be used when the diagnosis of penile fracture is being considered. However, given the time-sensitive nature of this diagnosis, this is not a common occurrence in most practice settings.[110,111]

Treatment

Catheters and Urinary Diversion

For trauma patients, placement of a urinary catheter is often indicated to monitor resuscitation and fluid status, as well as for logistical reasons in a critically ill, bed-bound patient. It is recommended by the American Urological Association guidelines for many renal and GU injuries such as bladder rupture or straddle injury to the urethra (grade C evidence, considered "low" quality).[55] For patients with diagnosed or suspected renal and GU trauma, however, this decision is slightly more complicated.

A common question in the ED is whether to attempt placement of a urethral (Foley) catheter in patients when there is even a remote possibility of a urethral injury. The question is particularly pertinent in the initial evaluation and

resuscitation: Will urethral catheterization make a patient worse, potentially turning a partial tear into a complete perforation? A retrospective study of 46 patients with urethral and bladder trauma found that blind urethral catheter placement was attempted in 91% of patients. They could find no evidence that this attempt worsened the initial injury, including in patients with blood at the meatus.[112] In a review article on the history of urethral trauma, Mundy and Andrich argued that, in the modern era of urinary catheters and antibiotics, a blind attempt at urethral catheterization is unlikely to cause additional harm and is a reasonable approach in a trauma patient who requires one, with the caveat that adequate confirmation of bladder placement is necessary.[38] Despite these studies, blind catheter placement is best avoided, especially if multiple attempts are needed.[104]

In cases of urethral injury associated with pelvic fracture, suprapubic tube placement is now preferred.[55] It should be noted that, if urethral catheterization is attempted, successful passage does not exclude the possibility of a small or incomplete perforation of the urethra. In a trauma patient, the inability to easily pass a urethral catheter mandates stopping for urethral imaging and passing it over a guidewire or placing a suprapubic catheter.[23,38]

Suprapubic Catheterization

Suprapubic catheter insertion is rarely necessary but may be a consideration in select circumstances (eg, prolonged patient immobilization), and some cases of severe bladder, urethral, or genital injury.[67] Patients with a pelvic fracture-associated urethral injury should receive a suprapubic catheter.[55] Likewise, patients with a straddle injury of the anterior urethra are at high risk for a delayed stricture; if placement of a urethral catheter is not possible or advisable, a suprapubic catheter is recommended.[18,42] For patients with bladder trauma, recent studies have found fewer complications and shorter hospital stays with urethral catheters,[15,113] leading consensus guidelines to recommend placing them for 2 to 3 weeks.[55.114] For anterior or posterior urethral injury, primary surgical repair versus suprapubic catheter with delayed repair is an ongoing area of controversy and is left to the discretion of the urologist.[5,67,98,115] Delayed repair with primary placement of a suprapubic catheter (or sometimes a urethral catheter) is increasingly used as part of a damage-control approach to GU trauma in the polytrauma patient.[116]

Alternative Methods of Urinary Diversion

In some cases of complex trauma, particularly to the upper urinary tract, alternative methods of urinary diversion, such as ureteral stents and/or percutaneous nephrostomy are indicated. This is the current expert consensus (evidence grade C) for patients with complications of renal or GU trauma (eg, expanding urinoma, increasing pain, infection), and for those requiring delayed surgical repair.[26] The possible need for such urologic procedures and collaborative planning of

care makes involving urology colleagues early in the process highly beneficial. Early, rapid, temporizing urologic intervention to divert urine reduces future complications such as infection, ileus, and chemical peritonitis.[116]

Surgery

The decision for intervening operatively or with interventional radiology on a patient with renal injury is guided mainly by hemodynamic stability, and any patient who is unstable and unresponsive to resuscitation should undergo immediate intervention.[55] This approach is much more conservative than previous guidelines, with hopes of decreasing the number of nephrectomies.[117] Ureteral injuries are also commonly treated primarily with stenting or nephrostomy (a surgical procedure that creates an opening in the kidney to drain urine directly into a bag outside the body), although debridement and primary anastomosis may be required for severe injuries such as complete transection.[26] Intraperitoneal bladder ruptures do not usually heal spontaneously and typically require operative exploration and repair. Extraperitoneal ruptures can usually be managed by placing a urinary catheter, which promotes bladder rest and healing.[118] Immediate surgical repair of urethral trauma is rarely indicated, but these injuries must eventually be managed definitively surgically to minimize the likelihood of erectile dysfunction, incontinence, and stricture formation.[119]

The 2 most common indications for surgical intervention with genital trauma are penile fracture and testicular rupture, and urgent repair should always be considered.[26] The goals for surgery in penile fracture are to restore function and cosmesis, but also to evaluate for and treat urethral injuries, which are common.[54] Early intervention for testicular rupture leads to lower rates of testicular necrosis and orchiectomy.[120] Other indications for surgical intervention include large scrotal hematomas, hematoceles, testicular dislocation, scrotal or penile amputation, penetrating injury, and female genital injuries such as large hematomas and lacerations.[48,76,121] If imaging is equivocal or the clinician remains concerned despite reassuring diagnostics, surgical exploration should be performed, as these injuries can have long-term consequences if left untreated.[55]

Interventional Radiology

As conservative management of GU trauma becomes more prevalent, with resulting lower rates of nephrectomy, interventional radiology has been used with increased frequency, both for diagnostic and therapeutic indications. Angiography can be used to evaluate for continued bleeding, and embolization of the kidney can then be performed to minimize hemorrhage in patients who are hemodynamically stable. Angioembolization has a success rate in almost two-thirds of grade V blunt renal trauma, with significantly higher success rates in lower-grade injuries.[122] Besides active extravasation of contrast, arteriovenous fistulas and pseudoaneurysms can be treated by interventional radiology.[122]

Admission

Although the management of renal injuries has moved increasingly toward nonoperative and expectant management, consensus on whom to admit has not changed very much. Institutional practice will vary; however, expert consensus still supports admitting all patients with renal injuries, even grades I and II.[84,101] Some have suggested that patients with grade I injury without visible hematuria can be discharged home with close follow-up.[123] Trauma patients with higher-grade injuries with anticipated nonoperative management are admitted for bed rest, frequent check of vital signs, serial hematocrit testing, assessment of urine output and degree of hematuria, and potentially repeat CT.[62,124]

There is wide variation in practice from all fields when it comes to repeat imaging, inpatient monitoring, IV fluids, antibiotics, activity restriction, and the need/timeline for follow-up.[123] For IV fluids, there is no specific recommendation other than that required to maintain adequate urine output.[125] Prophylaxis with antibiotics is often recommended for the renal and GU trauma patient, although there is minimal evidence to support this, with most evidence grade C (expert consensus).[123,126]

It is traditional (and still widely practiced) to prescribe bed rest for patients with renal trauma.[123] The original paper recommending this dates back to 1968, recommending 3 weeks, with the first week taking place in the hospital.[127] Current guidelines are less conservative, and advocate early return to mobilization.[123] No expert guidelines or literature addresses return to sports or activities after conservatively managed renal or GU injury. Given that 25% of all renal injuries grade III or greater experience a secondary hemorrhage,[126] and that the most common time period in which to experience this is the first 2 weeks, that seems to be a minimum reasonable recommendation for patients going home.[123] A standard pediatric recommendation, which could be applied in adults, is 2 to 3 weeks off school and 2 to 3 months off sports.[128]

Special Populations

Pediatric Patients

Due to anatomic factors, children are at higher risk for sustaining blunt renal injury than adults, and it is less commonly associated with pelvic fractures.[43,114] In one study, kidney injuries accounted for only 3.5% of pediatric GU injuries but were found in 25.7% of those children requiring admission.[129] Bladder injury is also more common in the pediatric patient population.[43] History and physical examination are less reliable in pediatric patients, as children can have significant renal trauma without gross hematuria or hypotension.[130] The rate of nephrectomies in this population is significantly lower than that in adults, and this is likely due to a lower incidence of major trauma, as well as increased efforts to minimize long-term morbidity by avoiding surgical intervention.[131,132]

The management of ureteral, bladder, and urethral injuries in children is similar to adults, although most authors agree that minimizing unnecessary radiation is important.[26,114] Unfortunately, ultrasound is not a clearly equivalent alternative to CT in the diagnosis of renal trauma in the pediatric population, and although some authors suggest contrast-enhanced ultrasound may be equivalent, it is not available at most centers.[133,134] Sexual abuse must be considered in any child presenting with a genital injury.[48] If there is a suggestion of genital injury, a complete examination is recommended, often requiring an examination with sedation (or even under anesthesia) in young girls.[135]

Older Patients

The epidemiology of renal and GU trauma in patients aged ≥65 years is similar to that of adults aged <65 years. The kidney, bladder, and urethra are the most frequently injured GU organs. However, given similar mechanisms and injury severity scores, elderly patients tend to have more intensive care unit admissions, longer hospital stays, and a significant increase in mortality compared with younger adults. These differences are likely secondary to decreased physiologic reserve as well as pre-existing comorbidities.[136]

Controversies and Cutting Edge

Magnetic Resonance Imaging

Although MRI can provide more accurate images compared with CT, because of its higher cost, the time needed to acquire images, and its limited access, MRI is not routinely used to determine the extent of renal and GU injuries. Nonetheless, MRI may have some utility for patients who have iodinated contrast-dye allergies,[136] is superior to all other imaging techniques in diagnosing penile fracture, and is also excellent for diagnosing scrotal injury.[26] However, given that ultrasound can also be used for diagnosis of such injuries, is typically more readily available, and can be performed at the bedside, ultrasound is preferred in both instances.[55] MRI is never an appropriate imaging study for an unstable patient, and its utility in patients presenting with renal and GU trauma in the ED is limited.

Nonoperative Management

To reduce the rates of nephrectomy as well as the morbidity associated with surgical complications, there has been a trend toward more conservative management of blunt renal trauma. Strategies include close observation, the use of interventional radiology for selective embolization, and percutaneous treatments. Despite the use of more conservative therapies, the incidence of complications and death from these injuries has not changed.[37] Again, the only clear indication for operative management is hemodynamic instability that is unresponsive to resuscitation.[26]

Contrast-Enhanced Ultrasound

Ultrasound carries fairly low sensitivity when diagnosing renal trauma. Contrast-enhanced ultrasound is a newer imaging technique that carries higher accuracy, but it is still inferior to CT scanning. It involves injecting echogenic microbubbles into the circulation and visualizing the organ in question with ultrasound as the microbubbles enter the parenchyma, causing increased echogenicity. By brightening the parenchyma, discontinuity of the tissue is highlighted. Contrast-enhanced ultrasound can be used to diagnose lacerations, hematomas, and even renal hilar avulsion if there is absence of parenchymal enhancement with contrast. The number of microbubbles in the ureter, bladder, and urethra are negligible, making contrast-enhanced ultrasound unhelpful in diagnosing injuries to these organs.[137]

Disposition

Transfer

Only 1 article in the literature search reviewed secondary overtriage/unnecessary transfer of isolated renal trauma patients, but it found this to be very common.[131] Given the ongoing validation of nonoperative management for hemodynamically stable patients, especially those with low-grade injuries, guidelines to support this practice are lacking. In the meantime, emergency clinicians should discuss this with their local trauma surgery and urology colleagues to have an arrangement in place for patients who will not need or benefit from transfer to a level I or II trauma center. A 10-year, single-center analysis of data on 295 cases of a renal trauma protocol found that grade I and II injuries rarely needed intervention and did not require urologic consultation.[138]

Consultation

Any significant injury to the kidneys, ureter, bladder, or urethra should, at the very least, be discussed with and possibly evaluated by a trauma surgeon and/or urologist while the patient is in the ED. If urology or trauma surgery is not available within the hospital, transfer to a trauma center is appropriate. Most injuries to the upper GU tract do require admission, although a minority of these patients can be safely discharged from the ED if they have close follow-up after discussion with a urologist, they are hemodynamically stable, and their pain is well controlled. Most injuries to the genitals, including superficial lacerations and zipper injuries, do not generally require emergent urologic evaluation. However, crush injuries to the scrotum or penis should be radiologically evaluated via an ultrasound or RUG, respectively, to ensure that the testicles and urethra are not injured. Testicular dislocation, rupture, traumatic torsion, and penile fracture require emergent operative intervention. When in doubt, a urologist should be consulted regarding any injury to the GU tract to ensure proper follow-up.

Urinary Catheter Care

Some patients with anterior urethral injuries can be managed with an indwelling urinary catheter. If a patient has a positive RUG for anterior urethral injury, urology should be consulted to avoid blind catheter placement. Assuming there are no other injuries, these patients can be sent home with an indwelling catheter provided they are able to follow up closely with a urologist and understand strict return precautions. The catheter will remain in place until definitive management can occur. Delayed management can lead to strictures, erectile dysfunction, and infection, highlighting the importance of ensuring the patient understands that they must follow up promptly with a urologist.

Time- and Cost-Effective Strategies

- **Consider the diagnosis.** Because urologic injuries are rarely life-threatening, diagnoses are frequently delayed or even missed. If GU trauma is not considered in the patient with abdominal trauma, patients may suffer from significant unnecessary morbidity, so a high index of suspicion is required. Urinalysis is a very helpful screening tool to send early for any patient presenting with trauma to the abdomen, lower thorax, or flank, but it is not sufficient to rule out injury. A thorough physical examination as part of the initial secondary survey, including the perineum and genitals, will help to minimize missed diagnoses.
- **Use IV contrast when possible, and delayed images when indicated.** Assuming there are no absolute contraindications to its use, IV contrast should be used on initial CT scans for trauma to the abdomen, as it not only allows for better visualization of injuries but can also identify the need for emergent intervention. Extravasation of contrast on immediate or delayed images can indicate ongoing hemorrhage or urinary leak, respectively. If CT scans are performed without contrast, repeat imaging with contrast may be needed, which can lead to significant delays, as well as increased cost and radiation to the patient.
- **Involve urology early.** Emergent urology evaluation may be necessary for patients with urethral injury who present with urinary retention and abdominal distention, particularly if the emergency clinician is not experienced and credentialed in placing a suprapubic catheter. After an injury to the renal or GU tract has been identified, a urologist can help facilitate appropriate management, disposition, and follow-up, even if the patient presents with a nonemergent condition. This is particularly true for trauma to the genitalia, where ordering testing and imaging may be unnecessary and can lead to significant delays when operative intervention is required for exploration and potential repair.

1. **"I ruled out kidney damage with a normal urinalysis and sent her home. She came back with renal necrosis."** While a urinalysis can help risk-stratify and identify the severity of some types of renal trauma, a normal urinalysis is not sufficient to rule out the diagnosis. There are many case reports of patients with severe injuries and normal urinalyses, especially with vascular injury and penetrating trauma.

2. **"He had only a little blood at the meatus on examination, so I went ahead and tried to place a Foley."** For any patient in whom there is concern for possible urethral injury based on history, physical examination, presence of significant pelvic fracture on x-ray, or suspicious findings on initial CT scan, a RUG should be performed prior to attempting placement of a urethral catheter. Without this test, you risk turning a minor urethral injury into a major one.

3. **"Radiology hedged their read on our CT because we did the RUG before he went to CT."** The contrast from a RUG can make an accurate reading of a subsequent CT of the abdomen with IV contrast or a CT cystogram very difficult. Since the placement of a urethral catheter is not emergent, the CT imaging should be performed first, before performing a urethrogram to rule out urethral injury.

4. **"I diagnosed her posterior rib fractures with an x-ray after she was hit on the flank. Her abdominal examination and blood pressure were normal, so I sent her home. She came back with a grade IV renal laceration."** Patients presenting with blunt or penetrating trauma to the lower thorax, upper abdomen, or flank should raise your suspicion for underlying renal trauma. Depending on history, mechanism of injury, adjacent injuries (such as vertebral fractures) and presence and degree of hematuria, such presentations may require additional imaging for possible renal injury.

5. **"When we found his pelvic fracture, I called orthopedics and trauma, but I didn't think about a urethral injury."** Pelvic fractures (apart from acetabular fractures) are highly correlated to urethral injury. In patients who have difficulty or pain with voiding, hematuria with a pelvic fracture, or trauma to the genitals or pelvis, a urethral injury must be on your differential, even if the patient is admitted and cannot have the definitive test before going upstairs. Depending on the institution, this can mean a RUG performed downstairs, a discussion with trauma surgery/admitting service, or a urology consult.

6. **"I just assumed he couldn't urinate because he was anxious after his car crash and because we gave him fentanyl."** Inability to void is common in the setting of lower urinary tract injury. In the setting of abdominal or pelvic trauma, this complaint must be investigated with bladder ultrasound to look for retention and appropriate additional imaging (eg, CT cystogram, RUG) to ensure the inability to void is not masking serious injury. Missed bladder and urethral injury can cause significant lifelong morbidity.

7. **"His scrotum was so swollen, and he had so many other injuries from his motorcycle crash, I couldn't have possibly caught his traumatic testicular torsion."** Renal and GU trauma is rarely the "main event" in the sick polytrauma patient. ATLS guidelines mandate dealing with the life-threatening injuries first. However, genital trauma with marked physical examination abnormalities can and should be addressed on secondary or tertiary examination, with a plan in place for additional imaging, such as ultrasound, and appropriate subspecialty consultation. The time-sensitive nature of some types of genital trauma makes this especially important.

8. **"I assumed he had a penile fracture, but he was able to void, so I sent him home with pain medicine and a plan to see urology in the clinic in 1 to 2 days."** Penile fracture, most commonly caused by trauma sustained during sexual intercourse, is a surgical emergency no matter how severe it appears on physical examination or the patient's ability to void. Although urethral injury is a concern, repairing the underlying defect in the tunica albuginea is also essential for future sexual function and cosmesis.

9. **"We got a stat CT of the abdomen and pelvis when we saw the bullet exit wound on his flank, but we missed the ureteral injury because of how we ordered it."** Ureteral injuries are uncommon in general, but they are most commonly seen in penetrating trauma. A regular CT of the abdomen with IV contrast is not timed to catch most ureteral injuries. When the path of the projectile or stabbing implement (based on history or physical examination) is near a ureter or kidney, delayed excretory images performed roughly 10 minutes after contrast administration are required.

10. **"We called trauma when we saw the shattered kidney. When her FAST was positive and her pressure dropped, she went straight upstairs. Urology complained the next day."** Although in most institutions the management of critically ill trauma patients is dictated primarily by the ED and their trauma surgery consultants, any high-grade renal or GU injury benefits from early involvement of a urologist. Ideally, they are involved in the initial operative intervention to help with urinary diversion and lend expertise in renal salvage.

Summary

Renal and GU trauma occur in 10% of abdominal trauma patients. Injuries to this organ system can be subtle and challenging to diagnose, particularly in polytrauma patients with other life-threatening injuries. Early detection and appropriate treatment can help avoid lifelong morbidity and increased long-term mortality. Given the subtle nature of these injuries, the history and physical examination are important in determining the timing and nature of investigation. Normal urinalysis without hematuria, though sometimes used to reassure clinicians, is not sufficient to rule out renal or GU trauma. Although most adult patients with bladder injury will have gross hematuria or hypotension with microscopic hematuria (with notable exceptions), children may not show hemodynamic instability despite significant injury.

There is growing consensus on the diagnosis and management of these injuries, including a tremendous shift in the last 25 years toward nonoperative and minimally invasive management. Advances in CT and ultrasound imaging have allowed improved detection, prognostication, and long-term management of these patients. CT scan with IV contrast is the gold standard in evaluating for most renal and GU trauma, except for isolated testicular trauma. Nevertheless, some patients will require delayed excretory phase imaging and/or a CT cystogram to adequately diagnose their injury. Most patients with renal or GU trauma will be admitted for further observation, even if stable. Early consultation with a urologist in cases of renal and GU injury is vital in devising an appropriate plan and disposition.

5 Things That Will Change Your Practice

1. Digital rectal examination is not sensitive enough to rule out injury to the urethra. If suspicious, further testing should be conducted.
2. If a patient presents with a pelvic fracture and urethral trauma, suprapubic tube placement is recommended over urethral catheterization.
3. While MRI is highly accurate for diagnosing scrotal and penile injuries, ultrasound is preferred, given its availability and the time-sensitive nature of these injuries.
4. The absence of hematuria on urinalysis is not sufficient to rule out renal injury after trauma.
5. The standard CT abdomen and pelvis scan with IV contrast is often not sufficient to detect renal, ureteral, and bladder injuries. Delayed images and special sequencing are often required.

Case Conclusions

CASE 1

For the 23-year-old man with flank injury from an altercation…

The young man was rapidly resuscitated after he was found on primary survey to have a blood pressure of 85/49 mm Hg. He had a negative extended FAST examination, and his urinalysis was normal. After a rapid infusion of blood products, you and your trauma colleagues agreed he was stable enough for CT of the abdomen and pelvis with IV contrast. While he was transported, you called a stat urology consult. His initial scan showed a grade IV renal injury on the side of his penetrating trauma and possible stranding adjacent to that ureter. With close monitoring, you obtained 10-minute-delayed images that confirmed a ureteral injury with extravasation. He was taken to the operating room with trauma and urology for continued hemorrhage from concomitant injuries, where he underwent primary repair of his ureteral injury as well.

CASE 2

For the 46-year-old woman in the rollover motor vehicle crash…

You paged trauma stat while beginning to resuscitate and evaluate her. You decided not to place a catheter at this time due to concern for possible urethral injury caused by a presumed pelvic fracture. You knew a catheter would have to be inserted eventually, whether urethral or suprapubic, but that her hemodynamic status came first. A carefully performed vaginal examination revealed a vaginal laceration adjacent to her urethra. While her extended FAST was in progress, you paged interventional radiology for possible embolization of pelvic vessels, and to urology, given your concern for lower urinary tract injury. Her positive extended FAST and continued hypotension sent her to the operating room with trauma emergently. Because of the nature of her pelvic fractures, urology performed both a RUG and 1-shot IV pyelogram before placement of a suprapubic catheter.

CASE 3

For the 54-year-old man in the motorcycle accident…

After providing some pain-dose ketamine, you continued with his primary survey. He was intubated for continuing respiratory distress, and a chest tube was inserted on his left side. His dislocated testicle was covered in moist, sterile gauze. This alone was a surgical urological emergency, so you paged the urologist. The patient's penile shaft deformity was concerning for a penile fracture, which you knew was also a surgical emergency. You deferred performing a RUG out of concern for exacerbating his penile injury and held off on attempting to pass a urethral catheter. You discussed placing an ultrasound-guided suprapubic catheter with the urology consultant, but because she was 5 minutes away, you agreed to wait. In lieu of testicle ultrasound, the urologist planned to take him to the operating room once he was cleared by trauma surgery.

References

Evidence-based medicine requires a critical appraisal of the literature based upon study methodology and number of subjects. Not all references are equally robust. The findings of a large, prospective, randomized, and blinded trial should carry more weight than a case report.

To help the reader judge the strength of each reference, pertinent information about the study is included in bold type following the reference, where available. The most informative references cited in this paper, as determined by the authors, are noted by an asterisk (*) next to the number of the reference.

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CME Questions

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1. What is the genitourinary (GU) organ most frequently injured by blunt trauma?

a. Kidney
b. Bladder
c. Urethra
d. Scrotum

2. **What part of the GU tract is more commonly injured due to penetrating trauma, as opposed to blunt trauma?**
   a. Bladder
   b. Ureter
   c. Posterior urethra
   d. Kidney

3. **Which of the following historical elements is most sensitive in detecting bladder rupture?**
   a. Suprapubic discomfort
   b. Decreased urine output
   c. Inability to void
   d. Gross hematuria

4. **How is gross hematuria defined at baseline (red blood cells [RBCs] per high-power field [HPF])?**
   a. <5 RBC/HPF
   b. 10 RBC/HPF
   c. >30 RBC/HPF
   d. 100 RBC/HPF

5. **In a patient with blunt trauma, which of the following findings on initial CT scan of the abdomen requires delayed excretory images 10 minutes after the administration of contrast?**
   a. Acetabular fracture
   b. Grade III renal injury
   c. Ureteropelvic junction hematoma
   d. Anterior urethral disruption

6. **A patient suffering blunt abdominal trauma complains of suprapubic pain and has gross hematuria. Initial CT of the abdomen and pelvis with IV contrast is normal. What is the best way to determine whether she has a bladder injury?**
   a. Clamp a Foley catheter, let her bladder distend, and perform a CT scan.
   b. Instill diluted contrast in the bladder and perform a CT scan.
   c. Wait 10 minutes after her initial IV contrast bolus and perform a CT scan.
   d. Send her back for arterial phase contrast and perform a CT scan.

7. **A 37-year-old man presents with penile pain that occurred during sexual intercourse and is found to have significant ecchymosis and swelling of the penis. He is unable to urinate, and physical examination reveals blood at the urethral meatus. Which of the following is NOT appropriate?**
   a. Placing a suprapubic catheter
   b. Contacting urology immediately
   c. Providing analgesia
   d. Blind insertion of a urinary catheter to decompress the bladder

8. **Regarding retrograde urethrography (RUG), which statement is FALSE?**
   a. RUG cannot be performed if a urinary catheter is already in place.
   b. RUG can be performed by an emergency clinician.
   c. A scout image is typically obtained first.
   d. A lack of contrast entering the bladder suggests urethral transection.

9. **Which of the following diagnoses requires immediate operative intervention?**
   a. Grade III renal laceration
   b. Bladder injury with gross hematuria
   c. Testicular rupture
   d. Ureteral injury with gross hematuria

10. **A 45-year-old man with no other past medical or surgical history sustains an isolated grade II renal injury after a fall from standing. He has no fever. What antibiotic regimen is recommended?**
   a. No antibiotics are indicated
   b. Cephalexin for 5 days
   c. Ciprofloxacin for 5 days
   d. Ceftriaxone IV for 2 days and then cephalexin for 5 days

The Clinical Pathway for Emergency Department Management of Suspected Renal Trauma can be seen on page 38.

Class of Evidence Definitions

Each action in the clinical pathways section of *Emergency Medicine Practice* receives a score based on the following definitions.

Class I
- Always acceptable, safe
- Definitely useful
- Proven in both efficacy and effectiveness

Level of Evidence:
- One or more large prospective studies are present (with rare exceptions)
- High-quality meta-analyses
- Study results consistently positive and compelling

Class II
- Safe, acceptable
- Probably useful

Level of Evidence:
- Generally higher levels of evidence
- Nonrandomized or retrospective studies: historic, cohort, or case control studies
- Less robust randomized controlled trials
- Results consistently positive

Class III
- May be acceptable
- Possibly useful
- Considered optional or alternative treatments

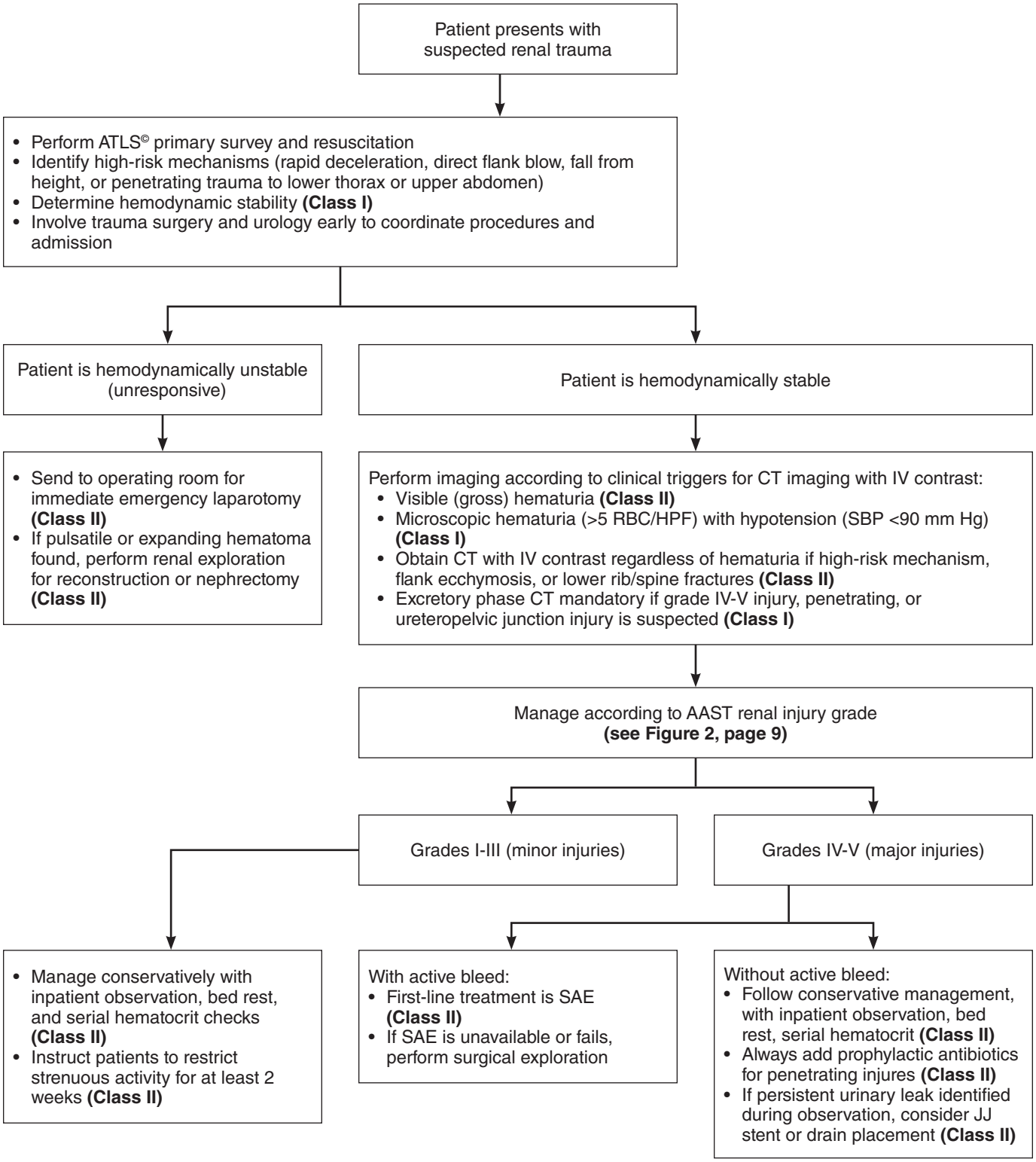
Level of Evidence:
- Generally lower or intermediate levels of evidence
- Case series, animal studies, consensus panels
- Occasionally positive results

Indeterminate
- Continuing area of research
- No recommendations until further research

Level of Evidence:
- Evidence not available
- Higher studies in progress
- Results inconsistent, contradictory
- Results not compelling

Clinical Pathway for Emergency Department Management of Suspected Renal Trauma

Click here or scan for interactive pathway



Abbreviations: AAST, American Association for the Surgery of Trauma; ATLS, Advanced Trauma Life Support; CT, computed tomography; HPF, high-power field; IV, intravenous; RBC, red blood cells; SAE, selective arterial embolization; SBP, systolic blood pressure.

See page 37 for Class of Evidence Definitions.

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QUICK READ

Points & Pearls

MARCH 2026 | VOLUME 28 | SUPPLEMENT 6

Emergency Management of Renal and Genitourinary Trauma: Best Practices Update

Points

- Kidney and ureteral injury occur primarily from rapid deceleration or penetrating trauma. Unrecognized compromise of renal vascular supply can lead to necrosis.
- Long-term consequences of renal and genitourinary (GU) injuries include hypertension, chronic kidney disease, erectile dysfunction, incontinence, and voiding issues, hydronephrosis, fistula, recurrent pyelonephritis, and nephrolithiasis.
- Pelvic fractures are seen frequently in patients with bladder or urethral trauma and vice versa.
- Nearly 25% of all bladder and urethral injuries associated with pelvic fracture are missed.
- Pre-existing urologic pathology that makes bladder sensation unreliable (such as neurogenic bladder) places patients at greater risk for missed injury.
- The first spontaneously voided urine sample, before fluid administration, is the most sensitive for hematuria.
- Urinalysis is not enough to rule out GU tract injuries. Get a CT scan with IV contrast, and if there is concern for collecting-system injury, get 10-minute-delayed excretory imaging.
- Intraperitoneal bladder rupture (the most common type) occurs at the superior dome, causing urine to leak into the peritoneal cavity. This typically requires operative exploration and repair.
- Extraperitoneal bladder rupture occurs along the inferior aspect, causing urine to leak into the pelvic cavity. These ruptures are managed mostly nonoperatively by placing a urinary catheter to promote bladder rest and healing.
- If concern for possible urethral injury exists, perform a retrograde urethrogram (RUG) prior to attempting placement of a urethral catheter. RUG contrast can interfere with CT reading, so perform the CT first to ensure you are not missing any other intra-abdominal injuries.
- Interventional radiology offers less-invasive diagnosis and therapy for GU injury, while angiography can evaluate for continued bleeding. Embolization can minimize hemorrhage in hemodynamically stable patients. Renal artery and ureteral injuries can be stented.
- Indications for surgery in genital trauma: penile fracture, testicular rupture, large scrotal hematomas, hematoceles, testicular dislocation, scrotal/penile amputation, and female genital injuries such as large hematomas and lacerations.
- Obtain CT with contrast in patients with 5-30 red blood cells (RBCs)/high-power field when there is hypotension, other signs of shock, concerning mechanism, or a positive FAST.
- Even for patients with no RBCs, strongly consider CT if there was rapid deceleration mechanism (high-speed motor vehicle crash or a fall from height), direct trauma to the flank (punch or kick) with significant pain and ecchymosis, or adjacent fractures of the ribs or spine.

Pearls

- A rapid deceleration mechanism should raise suspicion for GU injury.
- If there is blood at the urethral meatus or injury is suspected, get a RUG before inserting a catheter.
- CT cystography identifies bladder injury better than CT alone.
- Early use of a pelvic binder can aid clot formation in pelvic hemorrhage.
- A clean urinalysis does not mean there is a lack of serious intra-abdominal or retroperitoneal injury. Include history, physical examination, and risk factors in choosing further diagnostic testing.
- Extended focused assessment with sonography in trauma (EFAST) does not rule out a retroperitoneal bleed.
- Delayed onset of gross hematuria after injury raises the possibility of the rare but potentially life-threatening complication of renal artery pseudoaneurysm.

